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RECOMMENDATIONS CONCERNING THE USE OF PORTABLE PHOTOMETERS, PARTICULARLY FOR STREET LIGHTING MEASUREMENTS

The following notes, drawn up by the Technical Committee of the Society, are intended to afford guidance in the *use* of portable photometric instruments. Attention may be drawn to the existing British Standard Specifications dealing with their *construction* and *accuracy*, No. 230, 1935 (Visual Type) and No. 667, 1936 (Photoelectric Type).

(a) Visual Type Employing Separate Test Surfaces.

1. CALIBRATION.

Instruments should be checked against a standard light source at frequent intervals. Periodically the instrument should be completely recalibrated and the electrical connections overhauled. Where possible, when making important tests, the instrument should be checked before and after use, preferably by the operator.

2. ACCUMULATORS.

Accumulators should be kept fully charged and in good condition. Portable photometers are liable to be used at infrequent intervals; therefore it is important that accumulators should receive regular attention or they will deteriorate.

3. TEST SURFACE.

The test surface should be kept clean and matt, otherwise inaccuracies in readings will occur. Individual instruments should be standardised with their own test surfaces.

4. VIEWING ANGLE.

When taking illumination readings on the test surface the angle of view should be kept approximately at 30° from the normal, or other angle specified by the makers of the instrument. Test surfaces are not perfect diffusers, but, in general, providing the angle of the view is kept constant at 30°, the error due to this imperfection is not appreciable for angles of incidence up to 75°. If the angles of view depart appreciably from this value large errors may occur.

5. ELECTRICAL INSTRUMENTS.

Before taking readings care should be taken to set and maintain the pointer of the electrical instrument on its appropriate setting. In the case of lamps with short filaments, such as are used with these instruments, the change in illumination produced by an error of 1 per cent. in setting an ammeter will produce an error of about 10 per cent., whilst with a voltmeter the error is from 5 to 7 per cent. This indicates the necessity for careful attention to the adjustment of the current or voltage of the comparison lamp supply.

6. SETTING OF TEST SURFACE.

Care should be taken in levelling up the test surface in use. When measuring illumination in horizontal or vertical planes, care should be taken in adjusting the test surface to the horizontal or vertical plane. Most portable photometers are supplied with devices for the purpose.

7. TESTS AT HIGH ANGLES OF INCIDENCE.

When the angle at which the light reaches the horizontal plane exceeds 75° from the normal the determination of horizontal illumination E_h, should be made by calculation from a measurement of the illumination E_n, with the test surface normal to the direction of the incident light. Then:

$$E_h = E_n \cos \theta$$

where θ is the angle between the vertical and the direction of the incident light.

This calculation should be performed for each of the sources contributing to the illumination to be measured and the results added together.*

8. SCREENING OF STRAY LIGHT.

When testing street lighting installations where the degree of illumination is generally of a low order, stray light from road surfaces may form a large proportion of the light falling on a test surface placed normal to the incident light. Therefore, careful attention should be given to the screening of reflected light from the road surface.

9. CASTING SHADOW ON TEST SURFACE.

Care should be taken by the observer to avoid any obstruction between the test surface and any source of light contributing to the illumination which is being measured.

10. COLOUR DIFFERENCES.

Where there are large colour differences between test and comparison lamps, such as those arising with mercury and sodium electric discharge lamps, suitable colour correcting filters should be used and the appropriate factor applied to the readings obtained.

11. GENERAL SUGGESTIONS.

When a large number of test points is involved, it is suggested that, where possible, a survey of the site should be made before the actual test is carried out, in order to select appropriate test points, to measure the heights and angles of lamps to be tested at normal incidence, and to determine what precautions are necessary in order to eliminate the effect of extraneous light sources, etc. An hour devoted to this process should ensure a higher degree of accuracy in the final measurements.

*This process has been summarised in the British Standard Specification for Street Lighting (B.S.S. No. 307—1931, p. 16), in which a chart to facilitate such calculations is provided.

(b) Physical Type Employing Photoelectric Cells.

1. Calibration.

Instruments calibrated for normal electric and gas lighting should be checked at frequent intervals against a lamp which has been standardised at a colour temperature of 2,700° K*. Where possible, when making important tests, the instruments should be checked before and after use.

2. Battery.

Street lighting photometers usually require an illuminated scale, and therefore a battery is normally supplied. As these batteries give little warning before running down, it is advisable that a spare dry battery should be kept at hand.

3. Light Sensitive Surface.

The photoelectric cell should be carefully handled, and care should be taken to avoid damage to the light-sensitive surface owing to scratching, accumulation of dust, etc.

4. Angle of Incident Light.

Readings should be made with light incident on the light sensitive surface at angles less than 35° from the normal, unless there is evidence that the cell in question is sufficiently accurate at higher angles of incidence.

5. Zero Adjustment.

Before taking readings, care should be taken in setting the zero of the indicator. A small error in this setting may introduce a considerable error in readings of low illuminations.

6. Settings of Light Sensitive Surface.

Care should be taken in levelling up the test surface in use. When measuring illumination in horizontal or vertical planes, care should be taken in adjusting the test surface to the horizontal or vertical. Most portable photometers are supplied with devices for the purpose.

7. Screening of Light Reflected from Road or Other Extraneous Light Sources.

When testing street lighting installations, where the degree of illumination is generally of a low order, the determination of horizontal illumination, E_h, should be made by calculation from a measurement of the illumination, E_n, with the light-sensitive surface normal to the direction of the incident light. Then:

$$E_h = E_n \cos \theta$$

when θ is the angle between the vertical and the direction of the incident light. This calculation should be performed for each of the sources contributing to the illumination to be measured and the results added together.*

Under such conditions the stray light from road surfaces may form a large proportion of the light falling on the light-sensitive surface. Careful attention should be given to the screening of reflected light from the road surface.

8. Casting Shadow on Test Surface.

Care should be taken by the observer to avoid any obstruction between the light-sensitive surface and any source of light contributing to the illumination which is being measured.

9. Colour Differences.

Portable photometers calibrated for normal electric or gas lighting will, in general, not read correctly for coloured light sources, such as mercury or sodium electric discharge lamps. In such cases factors given by the manufacturers should be used or photometers provided with specially calibrated scales or other means of correction.

10. General Suggestions.

When a large number of test points is involved it is suggested that, where possible, a survey of the site should be made before the actual test is carried out, in order to select appropriate test points, to measure the heights and angles of lamps to be tested at normal incidence and to determine what precautions are necessary in order to eliminate extraneous light sources, etc. An hour devoted to this process should ensure a higher degree of accuracy in the final measurements.

* This colour temperature is approximately that of a 230-volt 60-watt gas-filled filament electric lamp, complying with B.S.S. 161 for general service lamps.

* This process has been summarised in the British Standard Specification for Street Lighting (B.S.S. No. 307—1931, p. 16), in which a chart to facilitate such calculations is provided.

With a view to avoiding possible confusion with other publications, reference to these Transactions should be in the form :—" Trans. Illum. Eng. Soc. (London)."

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